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ECONOMIC ANALYSIS OF LAW[1]

THRESHOLD PROBABILTY

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CONTENTS

National Institute of Administration

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I

INTRODUCTION

The way in which rules and standards are applied either by the administrative authorities responsible for the enforcement of the various administrative sanctions or by courts, is a determinant contrivance that allows the behavior of individuals to fall within the proviso of legal rules.

The main function of Justice, as part of the legal system, is the enforcement and implementation of the law. Unimplemented legal rules have no effect on the social life they intend to regulate, that is, to frame human behavior so as to maximize social welfare.

[1] Conference held at the *Instituto Nacional de Administração (INA*), at the request of the Portuguese Court of Auditors, on June 1, 2010.

Our ground assumption considers that the behavior of individuals in relation to legal standards is the function of expected costs and benefits of lawful and unlawful alternatives.

The highlight of this discussion focuses on the theoretical analysis of the effects of modifications to sanctions provided by law and the probability of their enforcement. The models of unlawful conduct (including criminal behavior) deem that the individual acts rationally on the basis of expected costs and benefits, therefore substantiating the principle of rationality.

Under the concept of costs and benefits one can integrate those of material, psychological or moral nature. Theories of crime - more extensively theories of legal offenses - are abundant and are all based on factors of mental, physical, economic and cultural nature among others.

Over the last four decades the study of law and economics (also known as the economic analysis of law) has been developed, consisting in applying the methods of economics to law, which are based on the principle of rationality.

PRINCIPLE OF RATIONALITY AND INCENTIVES

The principle of rationality can be defined as follows: the individual seeks to maximize pleasure, utility, satisfaction, and self-interest while minimizing costs, disutility and displeasure. Simply put, the individual is a maximizer.

Usually, the rationality of individuals entails that whenever a conflict between the general interest and self-interests emerges, individuals tend to satisfy their own interests in detriment of the general interest. Already epitomized by Adam Smith[2] in *Wealth of Nations* in his famous metaphor of the "Invisible Hand", which embodies the principle of rationality:

> *"Many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was not part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good. It is an affectation, indeed, not very common among merchants, and very few words need be employed in dissuading them from it."*

[2] Smith, Adam; *The Wealth of Nations*.

Assuming that individuals pursue their own interests does not mean that they are "frigid" or "selfish" in a moral sense; it means that their behavior is based on the rational choice model whether it is motivated by ideological convictions or the benefit and satisfaction obtained in contributing towards the happiness of others, it is all in the profit of our own personal interest (they are components of the utility function or happiness function). The happiness of other persons contributes (and most often it does!) for our own satisfaction. In this sense nothing is disinterested. There is always interest even when acting at a non-material level and still when this interest merely reflects moral or psychological satisfaction withdrawn from decisions and behavior.

Thus, the utility function of a person (i.e. level of satisfaction) depends on all the material and non-material goods that person "consumes". The underlying rationality in the economic analysis of law does not infer a conscious calculation for all situations and choices made by the individual.

As stated by Gary Becker[3]"["[4].

> *"…human behavior is not compartmentalized, sometimes based on maximization, sometimes not, sometimes motivated by stable preferences, sometimes by volatile ones, sometimes resulting, in an optimal accumulation of information, sometimes not. Rather, all human behavior can be viewed as involving participants who maximize their utility from a stable set of preferences and accumulate an optimal amount of information and other inputs in a variety of markets."*

This passage from Professor Gary Becker reveals that the subject matter of economics is **non- compartmentalized human behavior** and that it can be applied to law. Non-market goods that seem not to appear related to the economy, only by mistake may be understood as such. Indeed, moral, ethical, religious and social values inculcated in

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[3] Becker, Gary; (1976) *The Economic Approach to Human Behavior*. (Chicago: University of Chicago Press. pp. 3-14.

[4] Criticisms have been levied against the rational choice theory mainly those that consider that the rationality of individuals is limited (bounded) by the information they have. In 1957, Herbert A. Simon (*A Behavioral Model of Rational Choice*) introduced the concept of "Bounded Rationality", interpreted as the assumption that individuals behave near-optimal in relation to their objectives in accordance to information available. See also, Kahneman, Daniel, Tversky, Amos. *Prospect theory: an analysis of decision under risk*. *Econometrica*, V.47, March 1979; Richard H. Thaler, *Doing Economics Without Homo Economicus,* in FOUNDATIONS OF RESEARCH IN ECONOMICS: HOW DO ECONOMISTS DO ECONOMICS? 227, 230-35 (Steven G. Medema & Warren J. Samuels eds., 1996).

individuals throughout their socialization process are goods that directly affect an individual's behavior and that can and ought to be studied.

As corollaries of the principle of rationality we underline the following:

a) Wanting more rather than less is preferable in all that provides satisfaction to the individual;

b) No one other than the individual knows best what gives him more pleasure; individuals know best what their preferences are and assign value to objects and their actions;

c) Free will as an assumption of free choice;

d) “Equilibrium” – interpreted as the pursuit of maximizing utility - impels individuals to alter their behavior in their social relations provided that their situation will improve with this change;

e) **The individual reacts to incentives**.

Based on these assumptions the theory developed by the economic analysis of law considers that individuals' choices are not random but instead decision-making is based on the expected results of a certain behavior or action, whether lawful or unlawful, under uncertainty and risk. Individuals make rational choices based on their personal equation.

In effect, all the choices of life are accompanied by a certain high or low degree of risk and of which are influenced by individuals' attitudes towards risk. These attitudes have great importance to the study of the effectiveness of the Law.

Granted that potential offenders of the law are rational in their decisions on whether or not to practice an unlawful act, individuals compare the costs and benefits of the different outcomes of their actions, including the risk of punishment, the possibility of social reprimand and psychological costs (moral costs). The unlawful act will only be committed if the expected benefits offset the expected total costs.

SELF-INTEREST AND PREDICTIONS

The premise that individuals pursue self-interest (rationality) allows the social analyst to predict human behavior in response to changes in stimuli (incentives) allowing for the elaboration of a valid behavioral model, whose utility depends on its ability to explain social phenomena, that is, proof of its efficacy shall be attained by contrasting the

results of the model's appliance to observed human behavior. To avoid confusion, the model aforementioned does not limit itself to quotidian individual models nor a small geographical area or short period of time. Instead, it is a general model that gathers a limited set of characteristics common to human behavior.

ALL INDIVIDUALS APPRAISE

Individuals are interested and concerned with just about everything in life: knowledge, independence, well-being of others, environment, honor, personal relationships, status, love, friendship, social standards, conduct, culture, wealth, time, music, art, religion and so on. Still, we are continuously making choices and substitutions offering a certain quantity of a given good in exchange for a quantity of another good and/or goods with greater value to us whether it be material or non-material (e.g. money, honor, safety). In this perspective appraisal is always relative given that the marginal value of a good tends to decrease as its quantity increases. On these grounds proponents of such view have defended the transitivity of preferences.

INDIVIDUALS ADAPT TO CHANGE

Everyone recognizes that in general individuals are capable of conceiving change in their surroundings. They are able to predict, although stochastically, the consequences of their actions and choices responding by creating new opportunities. The fact that at any given moment a person may be confined to limited options, knowledge or environment does not necessarily imply that the current situation is immutable. In fact, humans are able to find alternative means of action creating activities that broaden their possibilities in different directions. Economic theory assigns probabilities - expected values- to diverse actions selecting the one that has greater value (i.e., expected utility) for the individual.

One way to verify this ability to create new opportunities is to observe the effects that imposed restrictions enacted in new laws have on human behavior Legal rules - *substantive* and *adjective* – and the functioning of legal institutions create incentives that affect behavior in such a manner that on certain occasions not even legislators are able to predict.

When faced with new restrictions, individuals seek substitutive goods replacing the good whose cost – including *shadow prices* - has been altered although without confining the search to existing alternatives. From this angle, a legal provision may be relatively ineffective in terms of costs due to the individual's choice of substitutive goods.

ACTING UNDER UNCERTAINTY

It is a noteworthy fact that humans can never fully predict the results of their actions and choices, wherefore all decisions contain some risk[5]. The process of human life is stochastic, a concept substantiated in the uncertainty that stems from the various outcomes that can be observed from a “to do” or “not do” decision.

Determinism - opposed to a stochastic process - is that which does not exist during the process of human life. We are not certain of the consequences of personal relations that we establish at any level, the outcome of a trip in advance, the outcome of a financial investment, the time certain events take, even natural, nor their magnitude. In sum, we live in constant uncertainty. But this is the process of human life, we do not question it, it just is.

II

LAW AND OTHER REGULATORY SYSTEMS

Law is a random variable with an expected value, meaning that its enforcement is uncertain although it depends on the probability of its implementation which is less than one. An expected value of a random variable is defined as the integral of the random variable with respect to its probability measure.

INCENTIVES, AXIOLOGICAL SYSTEMS AND HUMAN BEHAVIOR

All human decisions begin with a mental representation where the effects of actions and/or behavior are not known in advance with upmost certainty. All actions and behavior contain a higher or lower degree of risk. Life, therefore, consists in a stochastic process which entails uncertainty and risk.

An individual acting rationally under uncertainty – characteristic of life in of itself - with available information and in line with his personal equation, seeks to attain the outcome that best meets his or her interests, to be precise, utility.

One may associate probability to risk. The probability that the individual assigns to possible anticipated outcomes is **subjective probability**, which may diverge more or less from objective probability due to the individual’s disregard of all factors.

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[5] Wilde, Geralde J. S.; (1994) Target Risk, p.1. *PDE Publications*, Toronto, Canada

Axiological systems - moral, ethical, social and religious – play a key role in decision-making by means of self-imputed sanctions (costs) as well as rewards obtained from law-abidance. These sanctions are divided into two sorts:

a) One of intrinsic nature which results in guilt ("price") felt by the individual when violating an axiological rule, whose intensity varies according to the order of offended values and the degree of adherence to those values instilled in the individual. An individual who is motivated to avoid feelings of guilt can be described as willingly honest and thus gains utility from his behavior. Hence, emotions and feelings (which we treat as preferences) influence behavior.

   One critique to the aforesaid is the Cartesian dualism between reason and emotion which led to the creation of the *homo economicus* and has distanced the overall analysis of behavior from the various sorts of intrinsic motivations of behavioral economics as well as other sciences that study the human being. Emotions are part of individuals' psychological structure and are also somehow related to the values inculcated during the socialization process, affecting an individual's *personal equation* and therefore behavior.

> **PERSONAL EQUATION** – We use the term *Personal Equation* to represent a set of beliefs, values and subjective knowledge. The personal equation determinately influences the behavior of the individual, varying spatially and diachronically. It is dynamic, meaning that new knowledge, beliefs and values inculcated in individuals alter behavior.

b) Another sanction is of extrinsic nature, that is, the criticism or threat of punishment the individual is subject to by the other members of society, to which the individual may be more or less sensitive depending on his values, beliefs and knowledge.

Likewise, the positive incentives of axiological rules brought forth as a result of the behavioral adjustment of individuals to the rules of these systems truly have effects on behavior.

THE LEGAL SYSTEM AS A SET OF INCENTIVES

Aside from the axiological systems mentioned the legal system may be understood as a set of incentives - positive and negative - acting upon the behavior of individuals although different from the former given that the infringement of its rules can be coercively sanctioned by the State.

LAW IS A RANDOM VARIABLE WITH AN EXPECTED VALUE. EXPECTED SANCTION

Law is a random variable with an expected value in the extent that the sanction imposed for the violation of legal rules is merely probable. This implies that the enforcement of a legal sanction depends on the awareness of such by the competent authorities, proof of its performance and the efficacy of judicial and enforcement systems.

In fact, the effectiveness of a legal rule does not emerge directly from it being in force instead it concurrently depends on the probability of its enforcement.

Regarding law as an expected value implies that the effectiveness of rules depends on the product of the magnitude of sanctions (or rewards) provided for in the law and the probability of their enforcement. Thus, sanctions (or awards) stipulated in legal rules are not *per se* the incentives that act upon individuals. Such incentives are incorporated in the expected sanction which is the outcome that results from the sanction foreseen in the law multiplied by its probability of enforcement. In this regard we cite Santos Pastor[6]:

> *"The law is an expected value ... what matters is not so much what the rules say but what the rules "do", - the role they actually play; this is why it is crucial to know how rules are applied and to what extent. "*

To illustrate this in a formal and simple way the **EXPECTED SANCTION** is expressed by the following equation:

$$S^e = S^* p$$

Where:

S^e – denotes the expected sanction;

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[6] Pastor Prieto, Santos. *Sistema Jurídico y Economía. Una Introducción al Análisis Económico del Derecho*. Madrid: Tecnos, 1989, p. 28. Translated.

S - is the maximum possible sanction provided by law;

p - represents the probability of law enforcement.

Such representation suggests that regardless of a high sanction provided by law (S), if the probability of law enforcement or apprehension (p) is low, the expected sanction will also be low.

Consider, hypothetically, that the maximum possible sanction set out in the Highway Code for driving under the influence with a blood alcohol level (BAC) of 0.8 g/ liter of blood is 500 Euros (S = 500 €). If the probability of apprehension in a particular geographical area, is 20 percent (p = 0.20), the stimuli, thereof, for the individual is represented by the expected sanction ($\mathbf{S^e}$) which in our example would be 100 € (= 500 € * 0.20).

We veraciously accept "rational" behavior as an assumption in our analysis – admitting to the fact that rationality of individuals is limited by the information available to them (bounded rationality[7]) – whereupon individuals are led to make choices so as to maximize their well-being, where not only is "reason" - in the Cartesian dualist sense - a determinant factor but also "emotions"[8], either basic or developed during the socialization process, that relate to the structure of values and beliefs (personal equation) of the individual. Cartesian dualism has been the basis for the severance between mind and body carried out in the various branches of science, including economics, creating an abstract fiction known as the *"Homo Economicus"* whose decision-making is based on reason alone, completely detached from feelings and emotions. *"Emotions are like a compass, they are there to guide us in the right direction. What good is a compass that is always stuck on north? Your emotions are meant to fluctuate, just like your blood pressure is meant to fluctuate. It is a system that is supposed to move back and forth, between happy and unhappy. That is how the system guides you through the world"*[9].

III

MAXIMUM SANCTION, MINIMUM PROBABILITY

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[7] Simon, Herbert A. (1955) – *A Behavioral Model of Rational Choice.* The Quarterly Journal of Economics. Vol LXIX, February, 1955.

[8] DAMÁSIO, ANTÓNIO R., *O Erro de Descartes – emoção, razão e cérebro humano*, 23rd ed. (Translated by Dora Vicente and Georgina Segurado), Mem Martins, 2003

--------- Damásio, António: *O Sentimento de Si.* - Publicações Europa-América –Lisbon (2000)

[9] Gilbert, Daniel –Interview for the Portuguese Magazine *Visão*., May 31, 2007, pp. 114-116.

3.1 THEORY AND CRITICISM

Gary Becker, in his famous article, *"Crime and Punishment: An Economic Approach"* (1968), argued that society can reduce social costs by reducing the costs of law enforcement (probability of apprehension) without sacrificing the level of deterrence. By increasing the sanctions provided in the law and reducing the probability of apprehension (detection and enforcement), the level of deterrence would remain unchanged while saving enforcement resources and reducing costs. The primary objective is to answer the normative question regarding the resources that ought to be used and the sanctions that should be employed to enforce the different types of laws in an effective and efficient manner. The probability of enforcement and punishments - in addition, their degree of severity - should be determined so as to minimize the social costs derived from unlawful conduct.

A field where Gary Becker has applied the theory of rational behavior has been crime and its punishment, he writes:

> *"A criminal, with the exception of a limited number of psychopaths, is assumed to react to different stimuli in a predictable ("rational") way, both with respect to returns and costs, such as in the form of expected punishment. Instead of regarding criminal activity as irrational behavior associated with the specific psychological and social status of an offender, criminality is analyzed as rational behavior under uncertainty." "Crime and Punishment: An Economic Approach, 1968", and in "Essays in the Economics of Crime and Punishment, 1974."*

If certain conditions were to be verified (especially if individuals are risk neutral), sanctions –primarily fines - should be set at the highest feasible level and limited by the wealth of the individual whereas probability of apprehension should be minimal since in this manner the social costs would be minimized and the expected sanction (which is the product of the imposed legal sanction multiplied by the probability of apprehension) would remain fixed at a constant level. This argument was ostensibly explained by Gary Becker.

A simplified form of the theory assumes that potential offenders accurately observe the objective probability of apprehension and correctly anticipate the expected sanction; meaning that actors have perfect or near perfect information, situation which rarely happens. The lack of information – imperfect information - has obvious consequences that generate inefficient outcomes. Further, the theory also assumes that individuals are risk neutral. In fact, individuals are not fully informed about the magnitude of the

applicable sanction for a particular offense given that it is subject to variance between a minimum and a maximum.

They may also lack a complete understanding of the social harm (including not only externalities but also internalized damages) caused when adopting socially inefficient behavior, that is, non-optimal behavior.

In addition, bounded rationality is another factor to take into account when determining the magnitude of sanctions and their probability.

3.2 ATTITUDES TOWARDS RISK

However, beyond the limitations aforementioned we must consider that the behavior of individuals is teleologically determined not by wealth or income (as composite variables) *per se* but by the expected utility or satisfaction they provide, implying that we must consider individuals' attitude towards risk when determining the optimal sanction, which we know varies subjectively and can either be risk-neutrality, risk-aversion or risk-seeking.

3.2.1. RISK-NEUTRALITY

Since risk-neutral individuals maximize both the expected value of results (Eg_i) and expected utility U [E (g_i)] - suggesting that both the sanction and its probability have equal influence on the level of deterrence – it's fair to consider that the probability of detection of an offense and apprehension, in a broad sense, should be as low as possible and the magnitude of the sanction S (severity) should be at the highest feasible level, with a maximum equal to the wealth (W) of the offender, (S = W) in order to maximize the social function, scilicet, minimize social costs.

The aggregate of instruments of direct risk management policy of driver behavior (probability and sanction) results in the expected sanction (**$S^e = S^* p$**). For risk-neutral individuals, if the fine is less than its maximum (maximum equal to an individual's wealth) and the intent is to increase the expected sanction, then society could reduce social costs by increasing the fine (severity) to a maximum so as to offset or compensate the decrease in probability (thus reducing the costs of law enforcement) without eventually affecting the level of deterrence[10]. In doing so, society obtains the

> A risk-neutral individual will act unlawfully if the probability of enforcement is lower than the ratio between expected private gains (g) and the fine **(p < g/S)**, in other words, if private gains exceed the expected sanction **(g > p*S)**

optimal expected sanction that best minimizes social costs.

Risk-neutral individuals compare the expected benefits of violating rules to the expected sanction.

3.2.1.1. CRITICISM OF THE MAXIMUM SANCTION, MINIMUM PROBABILITY MODEL

Several critical remarks can be made to this standpoint in what pertains to the argument of a maximum sanction (equal to the individual's wealth) and a minimum probability:

a) The assumption of risk neutrality is implausible in situations where individuals would face the risk of losing all their wealth by engaging in activities that impose low external costs;

b) If the magnitude of fines (severity) is disproportionate in relation to social harm, this would affect the social value of "JUSTICE" and the effects may be adverse. The values of a society, including vertical and horizontal equity, should be taken into account on the grounds that, quote, *"... one can not ignore the negative distributional effects of a policy measure and exclusively focus on its effects of efficiency, even if it is in terms of potential efficiency*"(Santos Pastor)[11];

c) Moreover, since wealth varies substantially among individuals, given a constant severity level of fines for all offenders, the optimal fine would tend be less than maximum. If it were greater than the wealth[12] of lower income individuals, an increase in severity combined with a reduction in probability - maintaining the expected sanction constant - would result in under-deterrence for those individuals unable to pay the fine[13];

d) Individuals have imperfect information regarding the probability of apprehension where in many cases estimates are to low while in others they are too high. This means that subjective probability differs from objective probability which implies the existence of perception errors [with endogenous determinants] with negative effects on

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[11] Pastor, Santos (1989) - *Sistema Jurídico y Economía. Una Introducción al Análisis Económico del Derecho*. Madrid: Tecnos,. p. 34. Translated.
[12] Polinsky, Mitchell and Steven Shavell (1991), "*A Note on Optimal Fines when Wealth Varies Among Individuals,*" American Economic Review, 81, 618-621.
[13] Bar-Ilan, Avner; Sacerdote, Bruce. *The Response to Fines and Probability of Detection in a Series of Experiments.* Working Paper No. 8638. National Bureau of Economic Research, December 2001.

optimal behavior. A high degree of uncertainty in regard to the probability of apprehension generates and promotes errors that are inversely related to the actual probability, i.e., the lower the actual probability the greater the size of the error. These relative errors may be minimized through individual experience due to a higher actual probability, considering that it is not static but rather dynamic. Consequently, the increase in resources allocated towards increasing the probability of detection of an offense and apprehension (administratively and judicially) and the decrease in the magnitude of fines can lead to more efficient behavior and as a result the expected sanction will tend to optimum.

e) If sanctions are set at extremely high levels, disproportionate to social costs, individuals will tend to develop evasive behavior more intensively in order to conceal illegal activities in which they engage. If the fine is too high, the potential offender will tend to raise fixed costs so as to avoid being caught engaging in externality creating activities, which, once incurred become *sunk costs*, and do not influence the potential offender's decision in relation to unlawful behavior. If the variable costs associated with unlawful behavior decrease (these which influence the potential offender's decision) the effect may be adverse.

f) By engaging several times in unlawful behavior, individuals who are fined occasionally (or just controlled) have the opportunity to obtain information on the actual probability of apprehension, which tends to reduce the discrepancy between subjective probability (perceived by potential offenders) and objective probability. This implies that reducing the fine below its maximum and increasing the probability of apprehension tends to be more efficient; increasing the level of general and specific deterrence.

In fact, information errors (such as those pertaining to objective probability) lead individuals to act and make decisions under a situation of disequilibrium. An increase in probability reinforces the dynamic component of the enforcement process, resulting in behavior that tends to adjust itself to equilibrium. This consists in drawing closer together personal estimates (subjective probability) to objective probability and, through this medium, induce individuals to adopt behavior that tends towards optimum.

Increased control combined with more effective law enforcement tends to foster the inculcation of certain socially significant values in individuals, changing the desired level of risk (target risk) and consequently, behavior.

In the long run this increase in deterrence caused by an increase in the objective probability of apprehension tends to create additional social benefits by stimulating individuals to act more efficiently.

g) Since the probability of apprehension and conviction also depends on judicial delay (in litigious cases) the greater the delay the greater the ***temporal discount rate*** of fines, entailing a reduction in the expected sanction, therefore lowering the level of deterrence[14].

3.2.2. RISK AVERSION

Risk aversion implies that when individuals act under uncertainty their expected utility is lower than the expected utility of certain returns or payoffs, although the expected tangible value of the results is the same.

For individuals who are risk adverse[15], the level of deterrence is the not the same for all the different combinations of probability and magnitude of fines in regard to the same expected value. As long as certain conditions are verified, the greater the sanction's severity the higher will be the level of deterrence for these individuals due to the ***risk premium*** they are wiling to sustain, which we know to increase with the absolute degree of risk. Furthermore, the degree of risk aversion - for those who are risk-adverse - is inversely related to an individual's wealth.

ABSOLUTE RISK AVERSION
Absolute risk aversion (ARA) is a measure of risk aversion. For risk adverse individuals, the absolute degree of risk varies inversely with wealth. Therefore, differences in wealth have an influence on behavior.

Given the risk premium willingly borne by these individuals, the total supported sanction **(S^T)** (aside from the internal and external moral sanction) shall be equal to the legal sanction **(S)** plus the risk premium (π) which reflects the cost of risk *per se* **($S^T = S + \pi$)**, implying that the optimal sanction (as well as the expected legal sanction) must be less than maximum. Note that the opposite scenario would lead to overdeterrence which would result in inefficiency. In all, the effect of risk on the welfare of individuals depends on three factors: the risk in itself, wealth (which directly affects the degree of absolute risk) and the individual's utility function.

[14] Polinsky, Mitchell and Steven Shavell (1999), "On the Disutility and Discounting of Imprisonment and the Theory of Deterrence," *Journal of Legal Studies*, 28, 1-16
[15] Polinsky, A.M.; Shavell, S. The Optimal... *Id.*, p. 880.

When individuals are risk adverse, the risk premium (which is part of the total supported cost) varies in the same direction of the legal sanction and inversely with the probability of apprehension.

The risk adverse individual will violate legal rules if and only if the expected utility of engaging in the activity outweighs the disutility (cost) that derives from the expected legal sanction plus the risk premium. The greater the severity of fines and the lower the probability, the greater the uncertainty and the "cost of risk" borne by these individuals. This indicates that the severity of sanctions in the case of risk adverse individuals can be lower than the maximum (i.e. less than wealth).

Since the decrease in the level of risk-bearing by individuals (including by those who adopt law-abidingness behavior) is a social benefit, increasing the probability and reducing the severity of fines achieves this objective. Nevertheless, an increase in probability suggests an increment of deterrence costs. Resultantly, there is a conflict between minimizing costs related to risk and minimizing the costs of increased probability. Consequently, optimal probability is that which best minimizes the sum of both costs (risk and probability).

For any given level of deterrence, the cost of risk-bearing can be reduced by decreasing the severity and increasing probability. The optimal magnitude of fines – inferior to the maximum feasible fine - depends on the offset between social benefits obtained from risk reduction and the marginal costs of the increased probability.

In conclusion: in cases of risk-aversion, an effective combination of law enforcement has the following characteristics:

a) Sanction severity is not set at its highest feasible level;

b) Probability shall be greater than that of risk neutrality cases.

An efficient situation entails that deterrence is not complete. Only those individuals to whom private gains from unlawful conduct exceed the external costs will engage in externality creating activity.

When the sanctions provided by law are already high, marginal increments will be less effective than increases in the probability of apprehension wherefore, according to the *"ratio-difference principle"*[16] – a psychophysical effect - the impact of any fixed positive

[16] Quattronc, George A. e Amos Tversky *in "Contrasting Rational and Psychological Analyses of Political Choice"* – The American Political Science Review, Vol. 82, No. 3 (Sep. 1988) 719-736, Study pertaining to the *Prospet Theory*.

difference between two amounts increases with their ratio. When the sanction (severity) is already high, its marginal increase will have a diminutive effect since the ratio is small.

Another factor that justifies high probability and low sanction severity is legal error committed by courts. These errors increase the risk imposed, not only upon individuals who violate the law but also others, generating social cost.

3.2.3. RISK-SEEKING INDIVIDUALS

In the case of risk-seeking individuals, an identical percentage change in probability and severity can have the same effect on expected *wealth* but have different effects on the expected utility of an offense and, consequently, the level of deterrence.

Increased severity triggers two effects: a substitution effect and an income effect. The substitution effect - caused by increased sanction severity - consists in less unlawful behavior. The sign (positive or negative) of the income effect depends on individuals' attitude towards risk. For risk-prone individuals the income effect is positive. In their case, an increase in potential severity for breaking rules generates a substitution effect in favor of law-abidingness but also yields a positive income effect more than enough to offset the substitution effect, therefore generating a total positive effect in favor of illegal activity. The efficacy of increasing probability tends to be greater than that of increasing severity. The expected reduction of income due to increased severity – when put in practice - may cause the individual to increase illegal activity. This occurs whenever the income effect outweighs the substitution effect.

Reducing the probability **(p)** and increasing the sanction **(S)** beyond a certain point will be counterproductive, where an increase in the expected utility of illegal behavior will reduce deterrence. Thus, for risk-seeking individuals, it is more effective to increase probability than to increase sanctions, maintaining the same level of the expected sanction.

IV

THRESHOLD PROBABILITY

4.1. In view of what is allegedly credited to Gary Becker regarding his insight on optimal enforcement policy, where *"maximum sanction -minimum probability"* is that

which – in theory - leads to the optimal sanction, we advance with some critical considerations.

We argue that the assumptions of this rule are rarely verified due to the several reasons already mentioned. Among these we draw attention to the fact that many individuals aren't risk-neutral and are either risk-adverse or risk-prone. These attitudes towards risk generate different effects when changing the combination of probability and sanction in order to obtain the same level of expected sanction. In the case of risk-seeking individuals, an increase in the probability will usually tend to be more effective than raising the severity of sanctions (an assumption also accepted by Becker).

However, many of the developed models founded on the theory of expected utility allow us to deduce that risk-neutral individuals when confronted with the choice between legal or illegal behavior, shall choose to violate the law whenever the expected sanction **(S*p)** is less than the expected private gain **(g)** obtained from committing an illegal act **(S*P < g).** Since these individuals maximize both the expected value of results and expected utility, it would be preferable – in this particular case - to raise the sanction to its maximum and lower the probability to its minimum. Nonetheless, due to the reasons already explained, even in this scenario this method would be inefficient.

Bearing in mind the degree of *constant absolute risk-aversion* **(CARA)**, some authors[17] have shown that in relation to risk-adverse individuals there will always be a level at which legal sanctions have some deterrent effects even under low probabilities of apprehension.

In respect to risk-seeking individuals, these models attest the fact that when the expected gain of illegal behavior is high or the probability of apprehension and conviction is too small, there is no deterrence possible even if the prescribed sanction is at its highest level.

Since it is the expected utility (or disutility) of actions that determine the behavior of individuals and since three risk attitudes are possible when choosing between legal or illegal behavior: preference, non-preference or indifference, we must take into account the level at which the individual's estimate of probability (subjective probability) makes

[17] Avner Bar-Ilan (June 2000) The Response to Large and Small Penalties in a Natural Experiment - (Department of Economics University of Haifa 31905 Haifa, Israel)

him indifferent between engaging in and abstaining from illegal activity. This probability is what we call THRESHOLD PROBABILITY[18] [19].

The case of indifference between engaging in and abstaining from illegal activity can be written as:

$$p^t U(W_1) + (1-p^t) U(W_2) = U(X_0)$$

Where:

pt – is threshold probability;

U – is the utility (satisfaction) of an action or certain behavior;

W1 – is the state of success (which comprises the positive result of an illegal act for the offender);

W2 – is the state of failure (which comprises the negative result of an illegal act for the offender,

p – is effective probability.

The consideration of this probability implies that regardless of the attitude of individuals towards risk [neutral, adverse or prone], if effective probability is positive but below threshold probability, the efficacy of sanctions provided by the law - in spite of their high magnitude - will be low or even null, given the system of moral values (in a broad sense) inculcated in individuals.

The notion of threshold probability signifies that if effective probability is lower than threshold probability, the magnitude of sanctions provided by the law shall be ineffective, leading to a situation where the benefits (utility) of engaging in illegal activity are greater than those of law-abidingness. Conversely, if effective probability is greater than threshold probability the efficacy of law enforcement tends to be high.

In order to reduce the number of offenses (namely crimes) the theory of threshold probability makes it evident that in spite of the attitude of individuals towards risk, increased probability of apprehension and conviction is more effective than increasing the magnitude of sanctions, especially when the effective probability is lower than threshold probability.

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[18] Polinsky, A. Mitchell; Shavell, Steven. (1979) The Optimal Trade off Between the Probability and Magnitude of Fines. *American Economic Review*, No. 69.
[19] Block, K. Michael and Lind, Robert C., (1975) C*rime and Punishment Reconsidered," JLS*

As stated above, the same holds true in the case of risk-seeking individuals. Withal, even when the effective probability is greater than threshold probability, the most effective tool in combating offenses is increased probability of apprehension and conviction which also includes the reduction of judicial delay. In effect - in situations of risk seeking - increasing the magnitude of sanctions while maintaining or reducing effective probability is counterproductive in relation to the desired effects, in other words, an increase in the magnitude of the sanctions under low probability of enforcement tends to increase the number of offenses (especially the crime rate).

This inefficiency can be mitigated if individuals have instilled moral values - ethical and social - that when breached, have corresponding "penalties" and "rewards" which can either be intrinsic incentives (feeling of guilt of disorderly conduct and satisfaction of law-abidingness) and extrinsic incentives (social approval or reprimand).

These "civic" values are determinants of persistent social and law-abiding behavior with respect for the moral and physical integrity of others.

Finally, the increase in probability may be carried out in various ways such as increasing control by law enforcement officials and increasing the efficiency and expeditiousness of courts.

4.2 EMPIRICAL RESULTS

In an empirical study conducted[20] concerning the determinants of road traffic accidents involving fatalities and injuries, by using econometric models we were able to obtain evidence to substantiate that several variables integrating these models were not statistically significant, mainly those pertaining to the rules that govern speeding and driving under the influence (BAC ≥ 1.2 g/l). These results indicate that many drivers are risk-seeking and as a result an increase in the magnitude of penalties provided by law shall be ineffective if the probability of apprehension is low and inferior to threshold probability. This is extensive to the case of risk-adverse and risk-neutral drivers.

Moreover, according to the theory discussed above, even in relation to risk-adverse or risk-neutral individuals the results of the model reveal that if the probability of apprehension for traffic offenses - such as speeding – is less than threshold probability, an increase in the magnitude of fines will be ineffective.

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[20] Donário, Arlindo (2007) *Análise Económica da Regulação Social: Causas, Consequências e Políticas dos Acidentes de Viação*

However, the policy of "Zero Tolerance" (included in our models as an explanatory variable of accidents involving fatalities and injuries) was implemented on several roads (stretches of road) during a period of time, showing signs of statistical significance in all models. This policy resulted in increased probability of apprehension and a constant magnitude of fines. This was enough to decrease the number of accidents and their consequences. This result attests the tenet that increased probability is, in the short run, a far more effective policy than increasing the magnitude of sanctions.

V

CONCLUDING REMARKS

When choosing between legal and illegal conduct, individuals take into account not only the expected legal penalties and rewards but also contemplate the axiological "sanctions" and "rewards" which emerge from the moral, ethical, social and religious values inculcated in them during the process of socialization, where “education” plays a key role. Strictly speaking, it is the overall penalty or reward that determines the individual’s decision on whether or not to abide by the law.

In the long run, education can play a crucial role in modifying individual preferences in what pertains to law-abiding behavior.

As mentioned, increased probability of apprehension and conviction also has an informative role and, if persistent, could lead to the inculcation of desired social values. Undeniably, it is a known fact that individuals from different countries do not share the same attitude towards law-abidingness and that their attitudes reflect their culture and values.

In countries where there is less internalization of respect for the law there is bound to be a greater tendency to engage in offenses and corruption that entail a reduction in deterrence. As a final note, it should be point out that even when legal sanctions are high and the probability of their implementation is low there will be a greater propensity towards corruption.

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